U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL WEATHER SERVICE
NATIONAL METEOROLOGICAL CENTER

OFFICE NOTE 239

On the Merits of the "Tendency Method" for the Spectral and LFM II Sea Level Pressure Forecasts

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JULY 1981

On the Merits of the "Tendency Method" for the Spectral & LFM II Sea Level Pressure Forecasts

For many years the sea level pressure forecasts from the 7L PE model (and the LFM model) have been computed by the "tendency method". This piece of jargon means that the sea level pressure forecast is formed by adding to the initial analysis of sea level pressure the change in pressure forecast by the model. This is in contrast to the forecasts for all other levels in the atmosphere which are computed by various forms of interpolation directly from the sigma-layer quantities forecast by the model, without reference to the initial analyses. An earlier study (unpublished) of the late 7L PE model indicated that use of the tendency method did help, thus prompting this study of the effects of the tendency method on The Spectral and LFM-II models.

The purpose, and presumed advantage, of the "tendency method" relates to the problems inherent in the reduction to sea level of surface pressure observations made at high elevations. The initial analysis of sea level pressure (and those subsequent analyses against which the forecast will be verified) contains, implicitly, the pressure reduction method either employed at the station observation points or built in to the particular analysis program. The pressure reduction method of the model, while patterned after that used at observation stations, is not (nor can it be) identical to either of the "analysis" pressure reduction methods. Thus, were the model output to be used directly, the possibility exists that the model pressure reduction could generate a forecast different from what which would be made if the station or analysis pressure reductions were used. And "different" probably would mean "worse", things being what they are.

Further, since all of these various pressure reduction methods are actually fictions, it behooves us to, at the very least, strive for consistency in our fictions. And all the more so since the verifications of the model forecasts are based on those same fictions.

The "tendency method" is an attempt to acheive such consistency. In some detail the method involves:

1) Given the initial (pressure coordinate) analysis and model sigma-layer initial conditions derived therefrom, the sea level pressure is reconstructed using the model's pressure reduction method, the same method as will be used for all forecast hours. This reconstructed pressure is a "zero-hour forecast", if you will.

2) The difference, RD, equaling the analysed pressure P_A, minus the zero-hour forecast pressure P_{oo} is formed and retained for later use. This RD field represents the initial difference between the two pressure reduction methods.

3) At the various forecast hours of interest (say 24), the model reduced pressure, P'_{24} is corrected by addition of the RD field and the sum, symbolized by P_{24}, is put forth as the 7L PE 24 hour forecast:

$$P_{24} = P'_{24} + RD$$

Substituting the meaning of RD gives:

$$P_{24} = P_A + (P'_{24} - P_{oo})$$

which clearly shows the origin of the name "tendency" method.

The potential difficulty with this method is in the use of the RD field for all forecast hours. Each grid point has its own RD value, representing the reduction difference at that location. And this in

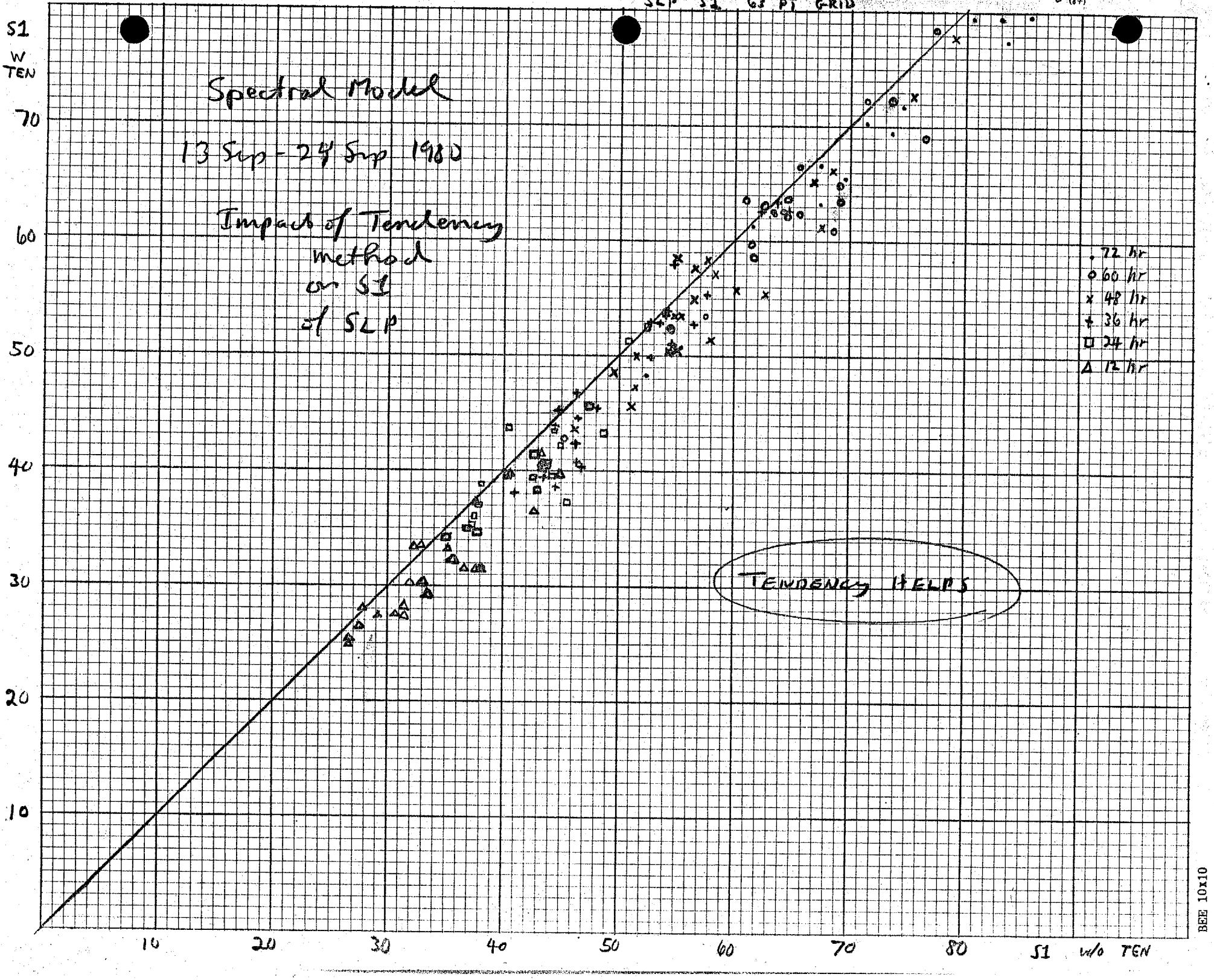
turn depends upon the meteorology there at the synoptic time when the RD value was formed. Presumably with a substantial change of weather there should come a substantial change in RD. But this is not allowed for in the tendency method: the same value is used for all forecasts of sea level pressure from 6 to 144 hours, (and beyond).

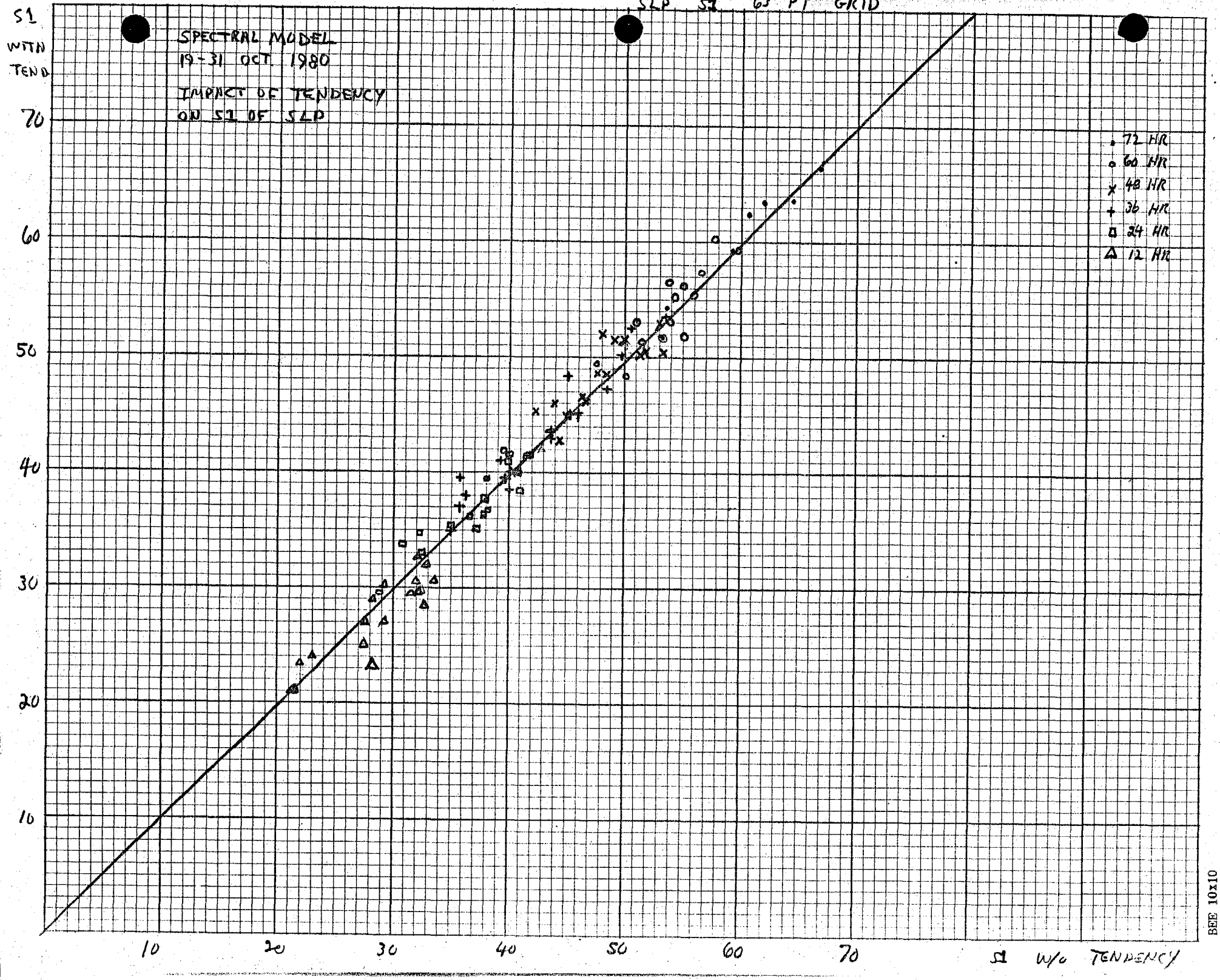
In order to assess the possible harm this difficiency might cause, and indeed to assess the value of the method itself, a series of tests were run. In these tests a collection of Spectral and LFM II forecasts of sea level pressure were verified in parallel to the same forecasts with the tendency method removed. The verifications were for 12 through 72 hour forecasts (at 12 hour intervals) and were assembled from a week or so of forecasts in each session. The verification score selected for presentation is the Tweles-Wobus S1 Score, evaluated on the 63 point 5°/10° lola grid which covers the U.S. and adjacent waters.

The results can be clearly seen on the "impact" graphs that accompany this report. In September 1980 Spectral with tendency did better than Spectral without tendency. In October 1980 and March 1981 there was virtually no difference, while in January 1981 Spectral with tendency was slightly better than Spectral without tendency.

LFM II forecasts were not available beyond 48 hours and no test was run in September 1980. For the other three periods LFM with tendency was better than LFM without tendency, although the difference was slight during March 1981.

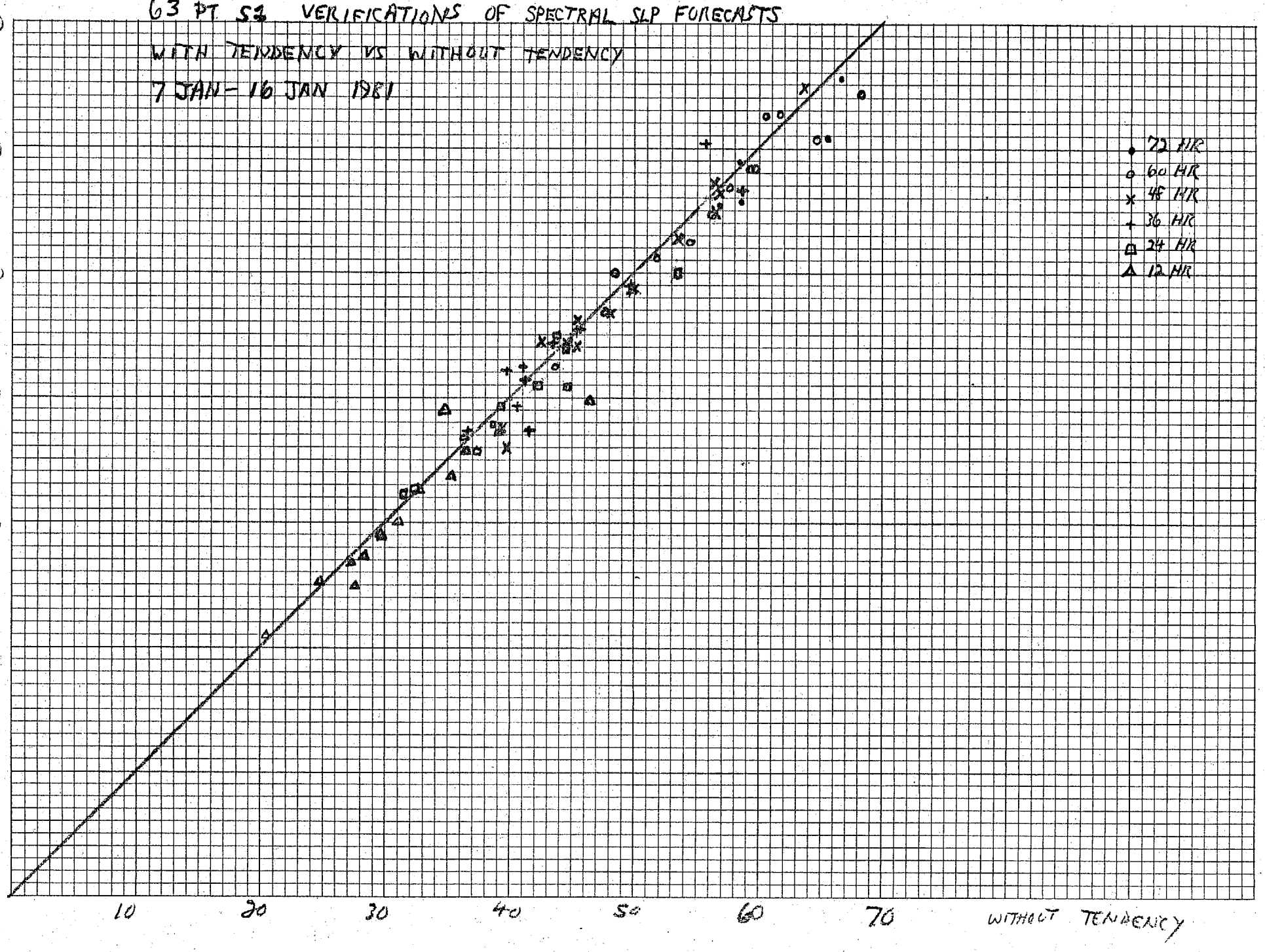
The LFM II model currently utilizes the tendency method, and it is recommended that it continue doing so. The Spectral model does not utilize tendency, but no recommendation is being made since the OI analysis may soon replace the Hough analysis. The OI analysis method (directly in sigma coordinates) does not allow for a tendency method correction.

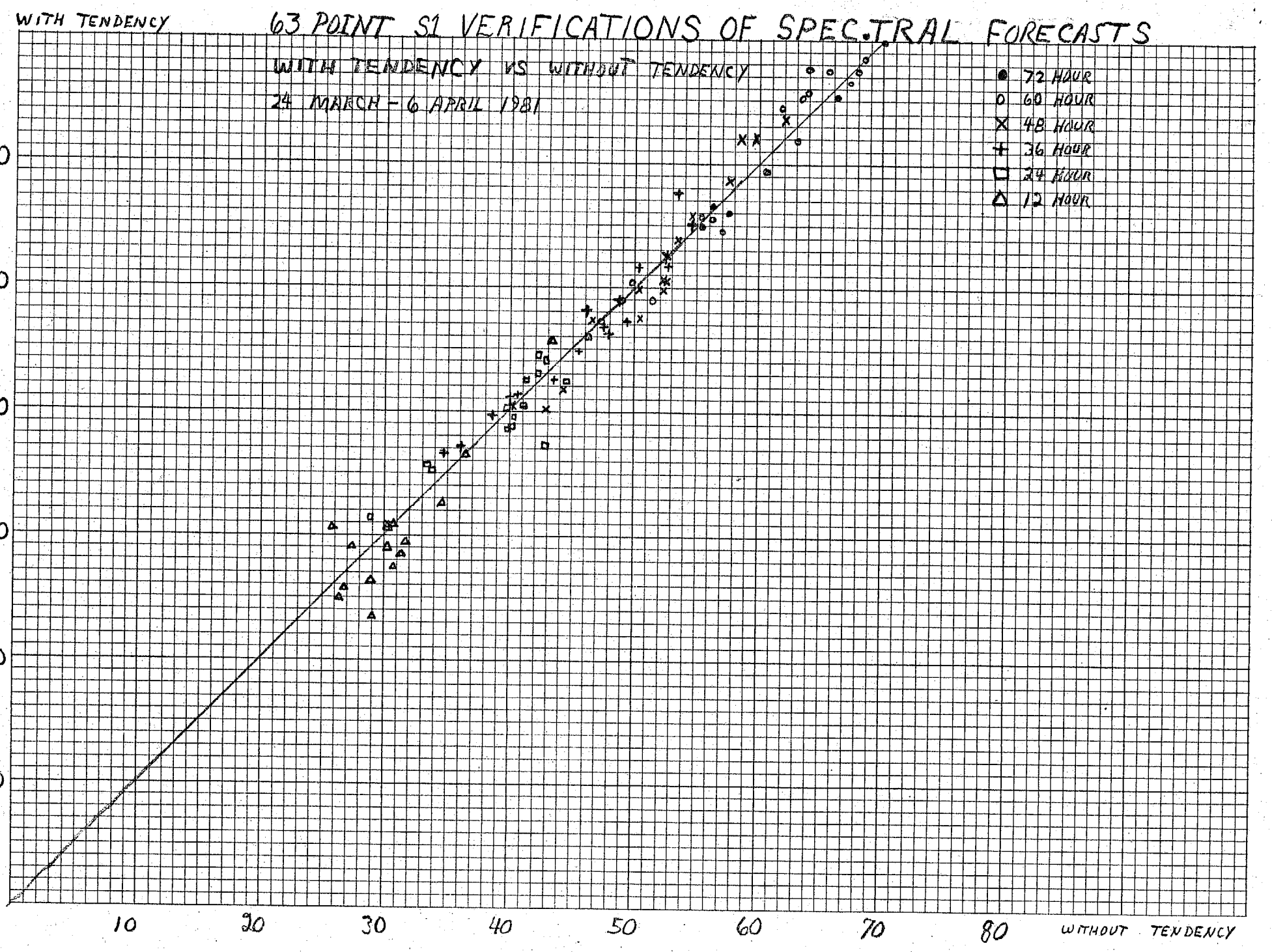

SLP S1 63 PT GRID
S1 W TEN
Spectral Model
13 Sep - 24 Sep 1980
Impact of Tendency method on S1 of SLP
72 hr
60 hr
48 hr
36 hr
24 hr
12 hr
TENDENCY HELPS
10
20
30
40
50
60
70
80
S1 w/o TEN

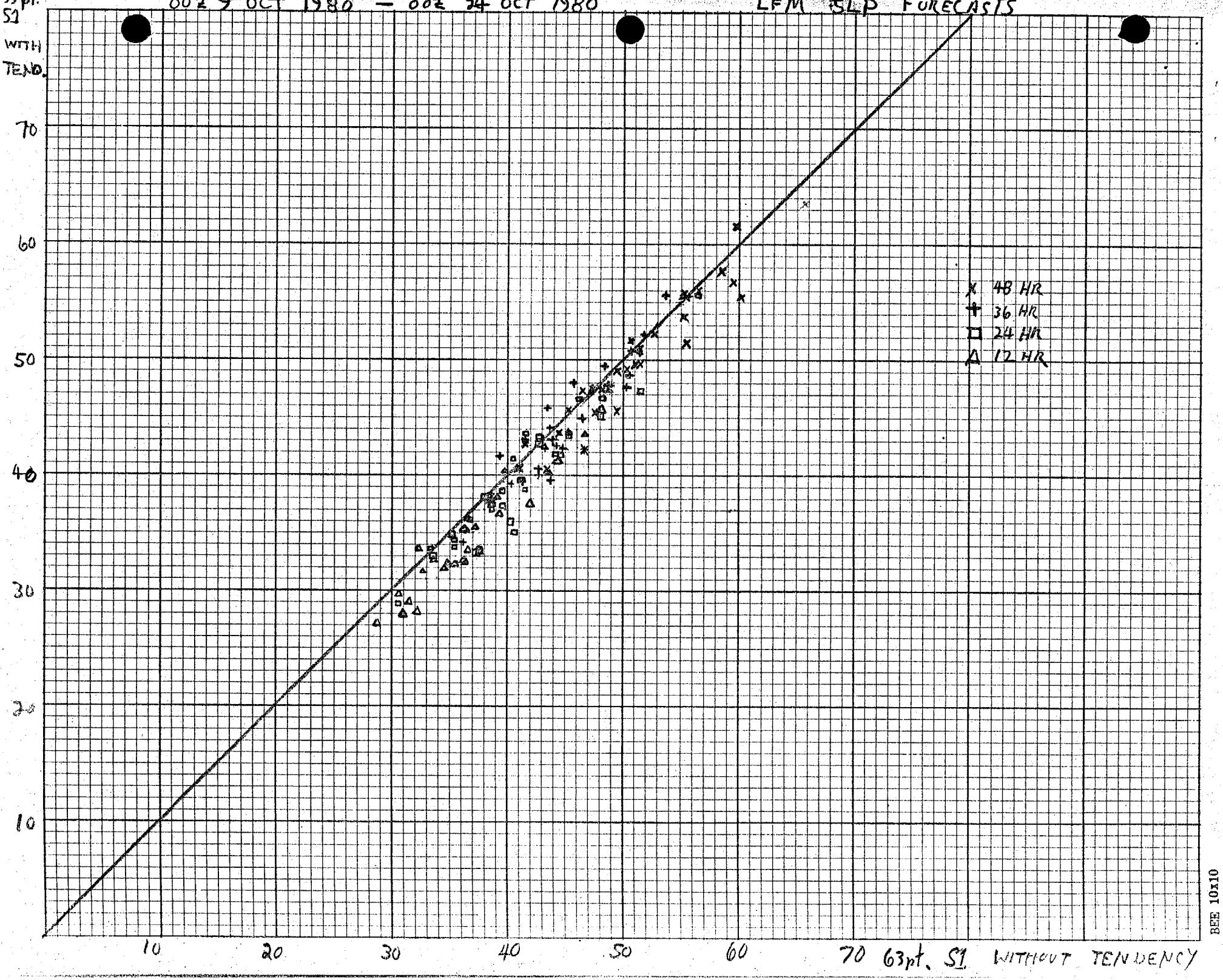

SLP S1 63 PT GRID
S1 WITH TEND
SPECTRAL MODEL
19-31 OCT 1980
IMPACT OF TENDENCY
ON S1 OF SLP
72 HR
60 HR
48 HR
36 HR
24 HR
12 HR
70
60
50
40
30
20
10
10
20
30
40
50
60
70
S1 W/O TENDENCY
BEE 10x10

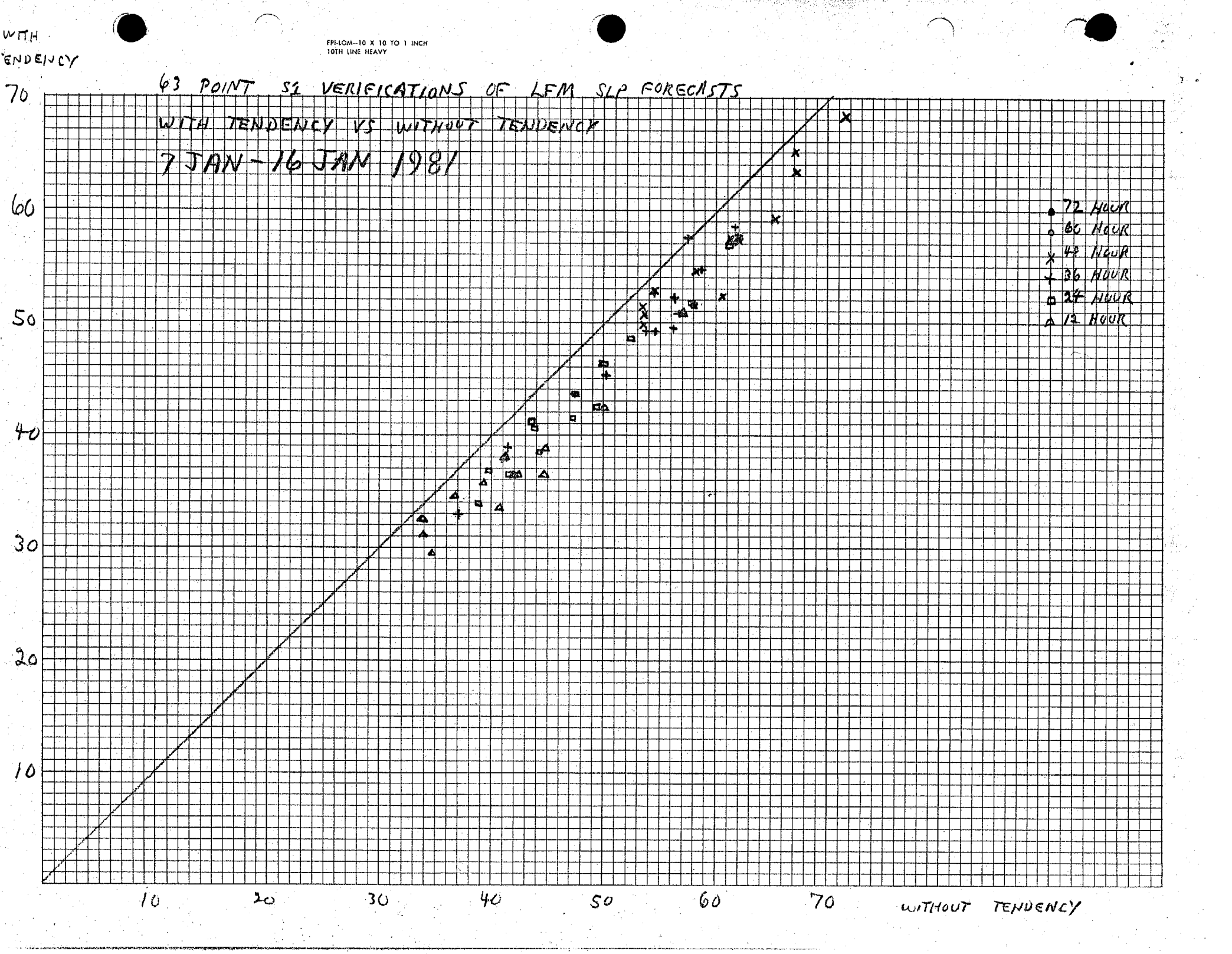
WITH TENDENCY

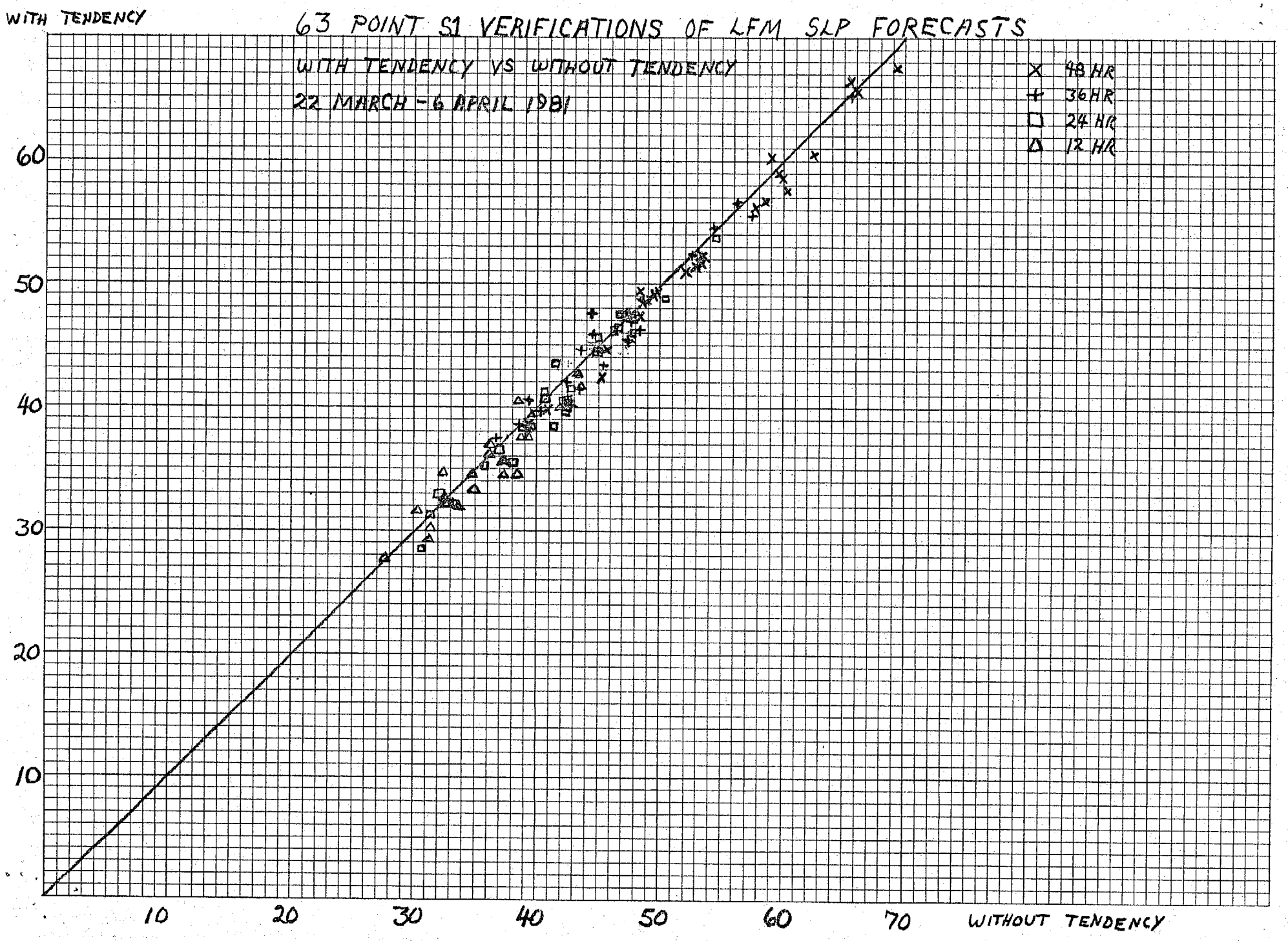
FPI-LOM—10 X 10 TO 1 INCH
10TH LINE HEAVY






002 9 OCT 1980 — 002 24 OCT 1980
LFM SLP FORECASTS
63pt. S1 WITHOUT TENDENCY
63pt. S1 WITH TEND.
48 HR
36 HR
24 HR
12 HR
10
20
30
40
50
60
70


63 POINT SI VERIFICATIONS OF LFM SLP FORECASTS
WITH TENDENCY VS WITHOUT TENDENCY
7 JAN - 16 JAN 1981
72 HOUR
60 HOUR
48 HOUR
36 HOUR
24 HOUR
12 HOUR
WITH TENDENCY
WITHOUT TENDENCY
10
20
30
40
50
60
70



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July 9, 1981 W324/JDS/CV

MEMO FOR THE RECORD

FROM: OA/W324 - J. Stackpole JDS
OA/W324 - C. Vlcek CLV

SUBJECT: "Tendency Method" for Spectral and LFM II SLP Forecasts

REF: NMC Office Note #239 (attached)

Sixty-three point Tewles-Wobus S1 forecast verification scores were used to compare the effects of using the "tendency method" vs no-tendency forecasts for the Spectral and LFM II models. Four sets of cases were run between September 1980 and March 1981. The results generally showed that either tendency helped or there was no difference. In no case was the tendency method inferior.

It is recommended that the LFM II should continue to utilize the tendency method. No recommendation is made for the Spectral model, since the OI analysis may soon replace the Hough analysis and the "tendency method" will no longer be possible.

Attachment